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Laboratory Manual of Cereals and Forage Crops

LIVINGSTON & YODER

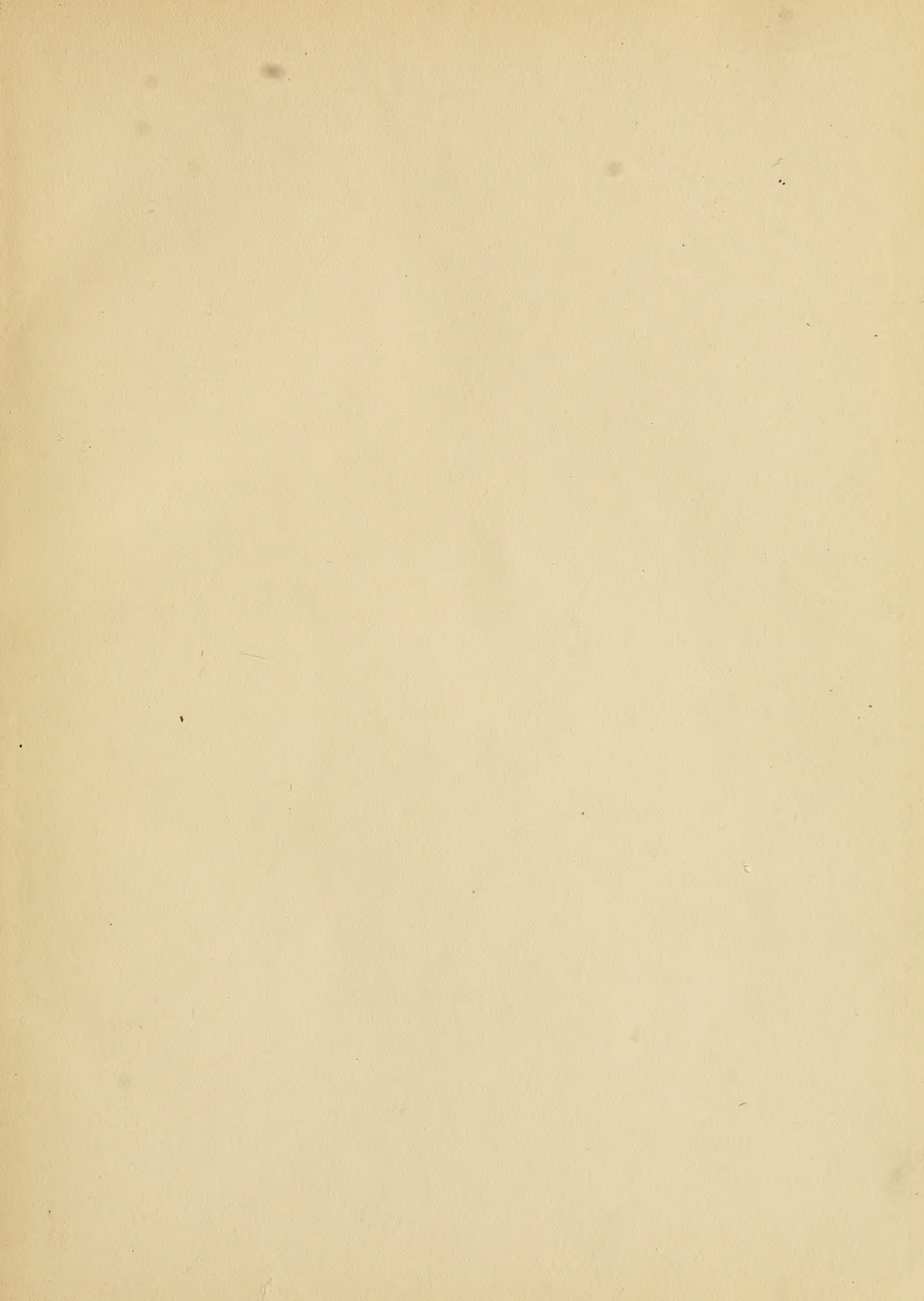


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OF

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PREFACE.

Almost all of the exercises contained in this manual have been given, during the past two years, as laboratory exercises in connection with the regular Cereal and Forage crop courses at the Ohio State University. For the most part the outlines and instruction sheets were run off on the multi-graph, on paper punched for insertion into loose leaf notebooks. While this system has some features to recommend it, it is on the whole more desirable to have them bound up in permanent form. More than one laboratory period, of two hours per week, will be required to complete all of the exercises, but when no more time is available, such exercises as are deemed most important may be selected for study.

Many suggestions have been gained from various sources, especially from Hunt's "Cereals in America" and "Forage and Fiber crops," Shoemsmith "The study of Corn," and Call and Schafer's "Agricultural Laboratory Guide." The rules governing the grading of grain have been included with the permission of J. F. Courcier, Secretary of the Grain Dealers' National Association, to whom the authors wish to express their thanks.

THE AUTHORS.

PRELIMINARY NOTICE.

- (1) Label all parts that are to be shown in each drawing.
- (2) Use a hard pencil (4H) in making the drawings, and ink them in at your convenience.
- (3) Use Standard Engineers' Note Book (8 x 10) which should be supplied with heavy paper for the drawings, and lighter paper for the notes.
- (4) Do not make the drawings too small, usually about one-half page. Use one side of the paper only.
- (5) Make the notes brief and concise. Use one side of the paper. Write with ink.
- (6) The following reference books should be consulted frequently in connection with the laboratory work. All can be found in the Library:
AGRICULTURAL BOTANY.....Percival.
CORN PLANTS.....Sargent.
CEREALS IN AMERICA.....Hunt.
EXAMINING AND GRADING GRAIN.....Lyon and Montgomery.
THE BOOK OF WHEAT.....Donlinger.
FORAGE AND FIBER CROPS.....Hunt.
THE BOOK OF CORN.....Shoesmith.
- (7) Bulletins of the Experiment Stations and the United States Department of Agriculture should be consulted in looking up references. They may be found in the Library.

EXERCISE 1.

DATE

CORN.

LABORATORY EXERCISE.

(Label all parts in each drawing.)

1. Draw a kernel of each of the following types of corn:

(Germ side up.)

1. Dent
2. Flint
3. Soft
4. Pop
5. Sweet
6. Pod

2. Make a longitudinal section of each of the above, showing:

1. Hull
2. Endosperm
 1. Hard or horny
 2. Soft or white starch
3. Germ
 1. Scutellum
 2. Plumule
 3. Radicle
4. Tip cap

3. Make a cross section of the same and draw with the germ side up, showing all the parts.

4. Make a comparison of these types of corn showing wherein they differ in regard to—

1. Size and shape of kernel
2. Location of hard and soft endosperm
3. Relative amount of hard and soft endosperm
4. Size and shape of germ

5. Make a drawing of a newly germinated kernel of corn, showing:

1. Plumule
2. Radicle
3. Coleorhiza

6. Make a drawing of a corn plant eight or ten days old, showing:
 1. Kernel
 2. Plantlet with unfolding leaves
 3. Roots
 1. Primary
 2. Secondary
7. Make a drawing of the roots of a mature plant, showing:
 1. Primary roots
 2. Secondary roots
 3. Brace roots
 4. Base of stalk
8. Describe in a general way the evolution of the root system of the corn plant from the time of germination to the ripened plant.
9. (a) Does the corn plant have a tap root?
(b) What is a fibrous root system?
(c) What physical factors might affect the root system?
10. Describe the arrangement of the leaves in the young plant.
Is corn a monocotyledon or a dicotyledon?
What is the distinction between them?
11. Draw a portion of a corn stalk bearing a leaf showing:
 1. Leaf sheath
 2. Leaf blade
 3. Ligule
 4. Auricle
 5. Rain guard
 6. Mid-rib
12. (a) Define node and inter-node.
(b) Are the inter-nodes the same length throughout the stalk? Why?
(c) Discuss the fibro-vascular bundles as to their location, structure and function.
(d) What is the structure of the pith? Its function?
(e) Where does growth take place in the corn plant?
13. (a) What is the arrangement of the leaves on the stalk?
(b) Where does the leaf grow from?
(c) Discuss the purpose of the leaf sheath, ligule, auricle and rain guard.

- (d) What gives the wavy effect to the leaf blade?
 - (e) What is the purpose of the mid-rib?
 - 14. What is a staminate flower? A pistillate flower?
Locate each on the corn plant.
 - 15. Is corn a self fertilizing plant? Explain the method of fertilization,
tracing the route of the pollen grain.
 - 16. What is a barren stalk?
-

EXERCISE 2.

DATE

SELECTION OF SEED CORN IN THE FIELD.

From the rows assigned by the instructor, select twenty ears of corn that in your judgment will be desirable for seed. In making the selection, the following factors should be considered:

- (1) Maturity
- (2) Environment
 - (1) Rate of planting
 - (2) Abnormal conditions favorable to growth.
- (3) Vigor of the plant
- (4) Ability to stand upright
- (5) Height of the plant
- (6) Height of the ear
- (7) Angle of the ear
- (8) Size of the ear
- (9) Freedom from disease.

In your notes tell how the above factors influenced your selection.

EXERCISE 3.

DATE

STORING OF SEED CORN.

Hang up the ears you have selected (employing the method indicated by the instructor) in the laboratory or store room. Label your selection with your name, date of selection and variety.

- (1) What is the essential factor to be considered in the storing of seed corn?
 - (2) What methods other than the one you employed might be used?
 - (3) Discuss drying of seed corn by artificial heat.
-

EXERCISE 4.

DATE

CORN JUDGING.

Before one is able to judge and select corn intelligently, he must be thoroughly familiar with all of the details of those factors which influence quality and seed condition in corn. Having once acquired a working knowledge of these details, it is necessary for him also to have a conception of the relative importance of the major points, such as maturity and seed condition, uniformity of grain, etc., as means of determining the value of any ear or number of ears for seed purposes. Too much emphasis is commonly placed on those factors which have to do with the appearance of ears. Ears of excellent appearance often yield less than others endowed with less beauty. Since, with our present knowledge of corn, yield cannot be associated with physical appearance with any degree of definiteness, more emphasis needs to be placed on the maturity, adaptability to local environment, and seed condition. These three factors are easily emphasized in the method of judging employed in exercise 4.

Several exercises with the outline in Ex. 4, and employing two ear samples of general classes of corn will enable one to gain familiarity with the qualities of corn.

Compare the two ears in two ear samples according to the points in the corn-judging sheet (p. 12), and record the differences which you find. Express the degree of difference as slight, medium, or marked, putting these terms in the column under the better ear.

EXPLANATION OF CORN JUDGING SHEET.

A. *Maturity and seed condition* is of first importance in the selection of seed corn. The assurance of a crop of corn, insofar as the selection of seed is concerned, is first determined by the vitality of the seed used and secondly by the earliness or lateness of the corn. Immaturity means not only lower yields, but also poor seed condition.

Maturity and seed condition are determined by:

1. *Hardness of grain and cob.* The grain should be firm so that it cannot be pressed into the cob. The ear should be firm and rigid when slightly twisted by the hands.

2. *Weight of ear in proportion to size.* An immature ear has a lower weight in proportion to its size, after it has thoroughly dried out, than one that is well matured.

3. *Color of ear and kernels.* Immature yellow corn has a dull mottled color of light and golden yellow. Many times the crown of the kernels are golden yellow with the tip of the hull showing a light color. Immature white corn has a dull white color. Ears that have been exposed to moisture conditions are dull or bleached. The cobs of immature corn are often dull in color.

4. *Color of kernels.* The tip of the kernel should not be pale. The germ in cross section should not be pale, dull, nor brown. The color should be light creamy yellow. There should be no white spots or a light colored streak from the crown to the tip on the side opposite the germ.

5. *Shape of kernels at tip.* Thickness at the tip indicates a large germ and well matured corn. A wide tip insures a large germ, a pointed tip, a small compressed germ.

6. *Size of kernels.* The kernels should be large, and quite thick, indicating a large germ and a plentiful food supply for the early life of the seedling.

7. *Size of germs.* A large germ indicates a vigorous embryo.

8. *Freedom from mold and fungus disease.* The presence of disease indicates not only poor seed condition of infected parts, but also susceptibility to rotting when planted, if inclement weather prevails.

9. *Freedom from breaking off of the tip caps.* Kernels from improperly stored or immature ears frequently leave the tip cap in the cob when shelled. The tip cap should remain on the grain to serve as a protection in case of unfavorable conditions in the soil. Breaking off of the tip cap is usually, though not always, associated with low vitality.

10. *Freedom from insect attack.* Any attack by insects reduces the vitality of the seed.

11. *Freedom from blisters.* Blisters on the kernels are due to the presence of an excess of moisture at harvest time or improper curing of the seed. They are associated with poor seed condition.

12. *Freedom of tip cap from cob chaff.* The presence of cob chaff on the tips of kernels after removal from the cob is an indication of immaturity.

13. *Proportion of hard to soft endosperm.* A high proportion of soft endosperm in the kernel is usually associated with immaturity.

Make a final placing of the ears for maturity and seed condition.

B. *Uniformity of kernels* is important as an indication of the purity of the grains in an ear of corn, and also of the accuracy of distribution by the planter.

Straight and uniform rows from butt to tip of ear insures the greatest possible uniformity in size and shape of kernels. Notice whether or not the indentation and color are uniform for all kernels in the ear.

Make a final placing for uniformity.

C. *Amount and proportion of grain to cob* not only influences the yield of shelled corn but also bears a direct relation to the feeding value of the corn. This point is of value in judging feeding classes. The proportion of grain to cob can be determined by:

1. *The weight of ear in proportion to size.* Other things being equal, the ear with the heavier weight in proportion to size has the higher percentage of grain.

2. *Depth of kernels in proportion to size.* The cob should not be too large, and the kernels should be fairly deep, the depth depending upon the type or variety and the latitude in which the corn was grown.

3. *Space between grains.* Any space between kernels reduces the weight of grain and the proportion of grain to cob. The kernels should be full and strong at the tip; and there should not be much space between the kernels at the tip when viewed in the ear.

4. *Filling out of butts and tips.* Any uncovered part of the cob reduces the amount of grain. While covered tips are not indicative of higher yielding corn, from the standpoint of feeding value alone it is important to have well covered tips.

Make a final placing for amount of grain.

D. *Shape of ears* does not seem to be directly associated with high yield, but it is important in that it influences uniformity in type, and amount of grain.

The sides of the ear should be straight, and the width of the ear should be carried well towards the tip. Unless variety standards specify otherwise, the tip should have an abrupt taper and a well rounded outline. The butt should be full and well rounded forming a depression at the shank.

The circumference should be approximately three-fourths of the length of an ear. Too large a cob lowers the proportion of grain and lengthens the drying process. A slender ear frequently carries shallow grains. Make a final placing for shape.

E. *Composition* is important from the feeding standpoint. High protein content is associated with a high proportion of horny to soft endosperm. A large germ indicates a high content of oil.

F. *Shank.* The shank or place of attachment should be neither too large nor too small. Too large a shank makes harvesting more difficult; and one that is too small is likewise objectionable because of the weakness of attachment.

Make a final placing of the ears studied, taking into consideration all of the above points.

EXERCISE 4.

CORN JUD

[illegible]

DATE

NG.

[illegible]

DATE

(Placing of ears within five-ear samples.)

[illegible]

DATE

(Placing of five-ear samples.)

[illegible]

CORN RECORDS. EAR-TO-ROW AND VARIETY.

Node Bearing Ear.

Count from first node visible above the ground. (Average of 10 hills.)

Leafiness of Plant.

Very leafy (V. L.) ; Leafy (L) ; Medium (M) ; Poor (P) ; Very Poor (V. P.)

Maturity.

Very early (V. E.) ; Early (E) ; Medium (M) ; Late (L) ; Very Late (V. L.).

Down Plants.

Plants standing at an angle of 30° or less with the ground.

Broken Stalks.

Stalks broken at a point 24 inches or more below the base of the tassel.

Barren Stalks.

No kernels produced.

Useless Plants.

Extremely small ears, or less than a dozen kernels.

Suckers.

Plants that do not have an independent root system.

Angle of Ear.

Erect (E) ; Medium erect (M. E.) ; Medium (M) ; Medium drooping (M. D.) ; Drooping (D).

Height of Stalk.

Measure to top of tassel. (Average of 10 hills.)

Height of Ear.

Measure to node bearing ear. (Average of 10 hills.)
(When two ears are present measure height of lower one.)

Brace Roots.

Very good (V. G.) ; Good (G) ; Medium (M) ; Poor (P) ; Very poor (V. P.)

EXERCISE 7.

DATE

FIELD STUDY OF CORN — EAR-TO-ROW.

Row No.....																									Total		
Hill Number.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Number	%
Stalks in hill.....																											
Suckers.....																											
Broken stalks.....																											
Barren stalks.....																											
Smutted plants.....																											
No. 2-eared plants...																											

General qualities of row:

Maturity Angle of ear.....

Leafiness of plant..... Height of corn.....

Height of plants..... Stiffness of stalk.....

Size of ear.....

Row No.....																									Total		
Hill Number.....	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	Number	%
Stalks in hill.....																											
Suckers.....																											
Broken stalks.....																											
Barren stalks.....																											
Smutted plants.....																											
No. 2-eared plants...																											

General qualities of row:

Maturity Angle of ear.....

Leafiness of plant..... Height of corn.....

Height of plants..... Stiffness of stalk.....

Size of ear.....

EXERCISE 8.

VARIETY STUDY OF C

[illegible]

DATE

WORK IN THE FIELD.

[illegible]

EXERCISE 9.

THE GERMINATION TEST OF SEED CORN.

Use the ears selected in Exercise No. 2.

With pins and tags number the ears from 1 to 20, consecutively.

Examine several kernels from each ear, and estimate the percentage of germination.

Record your estimate in the proper column in the outline.

MAKING THE TEST.

Place in the bottom of a germination box from 1 to $1\frac{1}{2}$ inches of moist sand. Cover this layer of sand with a piece of cotton cloth. Remove six kernels from various parts of each ear to be tested, and place them in the square corresponding to the number of the ear. Place another cloth over the kernels and cover with $\frac{1}{2}$ inch of moist sand. Examine the test and apply more moisture from day to day as needed.

When the test is completed make a careful examination of each kernel, and tabulate results.

Remove sand and cloths from germination box, and clean and return them to proper places.

DATE

RESULTS OF GERMINATION TEST.

Ear No.	Strong	Weak	Dead	Percentage of strong germination	Estimated germination
1.....					
2.....					
3.....					
4.....					
5.....					
6.....					
7.....					
8.....					
9.....					
10.....					
11.....					
12.....					
13.....					
14.....					
15.....					
16.....					
17.....					
18.....					
19.....					
20.....					

- (1) Compare your estimate of the per cent of germination with the actual results obtained by the test.
- (2) Write up a report of the test.
- (3) Explain the importance of an accurate germination test.
- (4) What factor may influence the reliability of the test?

EXERCISE 11.

DATE

THE MOISTURE TEST.

By shelling a few kernels from each ear make a composite sample representing the twenty ears selected in Exercise 2.

From this sample weigh up 100 grams for the moisture test.

Transfer the 100 grams to the distillation flask of the Brown-Duval tester. Cover the corn in the flask with high grade machine oil. This will require about 150 cc. Only oil with a flash point above 200° C. should be used. Connect the flask with the condensing tube and apply heat to the screen below the flask. So regulate the flame that it will require about 20 minutes for the thermometer to read 190° C. When this point is reached, extinguish the flame. After the water ceases to drop from the condensing tube, read the test.

Run the test in duplicate.

RESULTS OF MOISTURE TEST.

Sample No.	Per Cent. of Moisture.		
	1	2	Average
1.....			
2.....			
3.....			
4.....			

- I. Explain the principle upon which this test is based.
- II. What factors influence the moisture content of grain?
- III. If corn with 15% of moisture is worth 50c per bushel, what is the value, upon this basis, of the corn you have tested?
- IV. If corn with 20% of moisture is selling at 60c per bushel, what is the value, upon this basis, of the corn you have tested?
- V. Why should the farmer and feeder be interested in the moisture test?

EXERCISE 12.

DATE

FINAL SELECTION OF SEED CORN.

From the twenty ears that you selected from the field, select what in your judgment are the ten best ears for planting. This selection should be based upon the germination test and the points brought out in Exercises 6, 7 and 8.

- I. What are your objections to the ears discarded?
- II. What criticism can you offer against the ten ears selected?
- III. Do you consider "type" of much importance? Why?
- IV. In a few paragraphs, tell what are the essential things to be considered in the final selection of seed corn.

EXERCISE 13.

DATE

WHEAT.

(Label all parts in each drawing.)

- I. Make a drawing of a wheat spike as a whole.
- II. Remove all the spikelets but one (leave spikelet about midway of the rachis). Draw front view showing how spikelet is attached.
- III. Draw side view of the rachis with the one spikelet in position.
- IV. Draw a spikelet detached from the rachis.
- V. Dissect one spikelet each from a smooth and a bearded variety. Draw each part separately, arranging parts in proper relative position.
- VI. Draw a kernel of wheat showing:
 1. Suture.
 2. Cheeks.
 3. Brush.
- VII. Make a longitudinal section of the wheat kernel through the suture, and draw, showing:
 1. Germ.
 2. Bran.
 3. Endosperm.
- VIII. Make a cross sectional drawing showing the same parts as in Exercise VII, showing by shaded areas the differences in the physical characters.
- IX. Examine and make cross section drawings of red and white wheats. What is the difference between them?
- X. From the study of the spike, what four factors would materially affect the yield of wheat?
- XI. What is a spikelet? How many outer glumes per spikelet?
- XII. What is a sterile spikelet? A sterile flower?
- XIII. Why is a long brush objectionable in milling wheat?
- XIV. Is the germ on the side of the kernel next to the palea or the flowering glume?
- XV. Compared with corn, is the germ of wheat large or small in proportion to the size of the kernel?
- XVI. How does the shriveled kernel compare in its physical composition to that of the plump kernel? Which is the more desirable for milling purposes?
- XVII. What is the difference between the physical character of red winter and hard winter wheat? Red winter and spring? Red winter and durum? Red winter and white wheat?

EXERCISE 14.

DATE

VARIETY STUDY OF WHEAT IN THE FIELD.

(Four or five weeks from date of seeding.)

Variety.				
Vigor .....	.....	.....	.....	.....
Stand .....	.....	.....	.....	.....
Color of foliage.....	.....	.....	.....	.....
Presence of insects.....	.....	.....	.....	.....
General appearance.....	.....	.....	.....	.....
No. of plants per rod.....	.....	.....	.....	.....
Calculated plants per acre.....	.....	.....	.....	.....

Variety.				
Vigor .....	.....	.....	.....	.....
Stand .....	.....	.....	.....	.....
Color of foliage.....	.....	.....	.....	.....
Presence of insects.....	.....	.....	.....	.....
General appearance.....	.....	.....	.....	.....
No. of plants per rod.....	.....	.....	.....	.....
Calculated plants per acre.....	.....	.....	.....	.....

(In noting vigor, stand and general appearance, base the marking on 100 as perfect.)

- I. In the strip along the edge of the plot carefully dig up a wheat plant. Locate the seed grain, temporary roots, permanent roots.
- II. What influence has the depth of planting upon the location of the permanent root system? Is deeply planted wheat more likely to withstand a severe winter than that planted less deeply?

EXERCISE 15.

COMPARATIVE STUDY

(Lab)

Varieties.						
I. Stool—						
(1) No. of culms.....						
II. Culm—						
(1) Length (average of five plants).....						
(2) Foliage (scanty, medium, abundant).....						
(3) Color (light yellow, yellow, bronze, purple).....						
(4) Upper part of culm (solid, medium, hollow).....						
III. Spike—						
(1) Position (erect, leaning, nodding).....						
(2) Length (average of ten).....						
(3) Shape (tapering to tip or butt, uniform, club, flattened across or with spikelets, square).....						
(4) Awn (bearded, partly bearded, beardless).....						
(5) Length of awn (average of 10 spikes).....						
(6) Compactness (very open, open, medium, compact).....						
IV. Spikelet—						
(1) Shape (widely spreading, medium, narrow).....						
(2) Shattering (marked, medium, none).....						
(3) Outer glume (hairy, partly hairy, bald).....						
1—Color (yellow, light yellow, bronze, black).....						
2—Width (wide, medium, narrow).....						
3—Beak (long, medium, short).....						
(4) Number of grains per spikelet (average of five spikes).....						
(5) Number of sterile spikelets (average five spikes).....						
(6) Number of filled spikelets (average five spikes).....						
(7) Number of sterile flowers (average five spikes).....						
(8) Number of grains per spike (average five spikes).....						
V. Grain—						
(1) Hardness (very hard, hard, medium, soft).....						
(2) Size—						
1—Average weight of 100 grains.....						
*2—Average length of 100 grains.....						
3—Average width of 100 grains.....						
(3) Plumpness (plump, medium, shriveled).....						
(4) Cheek (flat, plump, angular).....						
(5) Crease (deep, medium, shallow; wide, medium, narrow).....						
(6) Brush (large area, small area—long hairs, short).....						
(7) Color (white, yellow, amber, red).....						

*Use coördinate paper, page 50.

tory)

DATE

[illegible]

EXERCISE 16.

DATE

VARIETY STUDY OF WHEAT IN THE FIELD.

(Exercise adapted for last of May or in June.)

Variety.				
Winter killing.....				
Vigor				
Stand				
Color of foliage.....				
Presence of insects.....				
No. of plants per rod.....				
No. of culms per rod.....				
Average No. culms per plant..				
Estimated plants per acre.....				
Estimated culms per acre.....				

Variety.				
Winter killing.....				
Vigor				
Stand				
Color of foliage.....				
Presence of insects.....				
No. of plants per rod.....				
No. of culms per rod.....				
Average No. culms per plant..				
Estimated plants per acre.....				
Estimated culms per acre.....				

(In marking winter killing, vigor, and stand, use 100 as perfect in each case.)

Write up a report of the exercise, with special reference to the important variations that came to your attention.

EXERCISE 17.

DATE

HEAD-ROW STUDY OF WHEAT IN THE FIELD.

Variety.	Row No.....					
Vigor						
No. of plants per row.....						
No. of culms per row.....						
Average No. culms per plant....						
Average height of plants.....						
Leafiness						
Color of foliage.....						
Color of stem.....						

Variety.	Row No.....					
Vigor						
No. of plants per row.....						
No. of culms per row.....						
Average No. culms per plant....						
Average height of plants.....						
Leafiness						
Color of foliage.....						
Color of stem.....						

Write up a report of the exercise, with special reference to the important variations that came to your attention.

EXERCISE 18.

DATE

WHEAT JUDGING.

Before one can judge wheat quickly and accurately it is necessary to become familiar with the points that are of importance in determining the value of a sample. This familiarity can be gained by careful study or long experience. The student must necessarily, on account of limited time, gain his knowledge by careful study. This study should be such as to enable him to see quickly in a sample, both the good and bad points, and with both in view, to arrive at an accurate decision. The following exercise was inserted with that object in view. By carefully analyzing several samples, especially prepared for the exercise, experience will be gained that will enable the student to analyze a sample easily without making the actual separations.

WHEAT JUDGING—DETAILED STUDY.

Obtain 20 gram samples of good and poor grades of wheat, and separate each according to the accompanying outline. Weigh the foreign matter and determine the remaining parts of the sample either by weighing or counting. Record all results in percent. The total percent for each division (i. e. purity, soundness, etc.) should be 100.

Purity. Decide upon the class of wheat (red winter, hard winter, white winter, hard spring, durum) that constitutes the bulk of the sample. Separate all other classes and record under "other wheat." Record oats, rye, barley, etc., as "other grain." The foreign matter constitutes all dirt, chaff, weed seeds and inert materials.

Soundness. Discard all "other grain" and the "foreign matter," and study the remainder of the sample for soundness. Sound wheat should generally be bright and free from broken, shriveled and sprouted grains or grains otherwise injured, as from stack or bin burning, exposure, or insect injury. Grains injured from stack or bin burning usually have a dark, dull color at the hilum end of the grain. All bleached grains have been injured from exposure.

Separate the sample into sound and unsound lots, and classify the unsound grains as broken, shriveled, sprouted and otherwise damaged.

Color. Since color is associated with purity, soundness, and texture, it is important to distinguish the colors frequently met with in wheat. In a large degree color is dependent upon classes and varieties of wheat, but it is also influenced by the injuries which cause unsoundness.

Separate the sample into lots representing the different colors indicated in the outline, and keep the lots separate for the study of texture.

Texture. The darker colored (dark amber) wheats are generally harder in texture (exception, durum) than those that are lighter in color. Amber colored wheats consist largely of grains with a medium texture, while wheats of a light amber color are mostly soft in texture. One exception is the light amber, durum wheat, which has a flinty texture. All yellow or white wheat is soft in texture. Make sections of a few grains of the various colors and note the general association of color of grain to texture.

Determine the percent of grains in the sample whose textures are hard, medium, and soft, respectively.

Size. Keeping in mind that the size of the grains of wheat differs for classes and also for varieties, obtain an idea of the sizes of large and small grains in wheat as a whole and then determine the percentages of grains in the sample which represent the large medium, and small sizes respectively.

EXERCISE 18.

DATE

WHEAT JUDGING---DETAILED STUDY.

No. of sample or variety.					
Purity.....	{	Wheat of class.....			
		Other wheat.....			
		Other grain.....			
		Foreign matter.....			
Soundness....	{	Sound grains.....			
		Broken grains.....			
		Shriveled grains.....			
		Sprouted grains.....			
		Otherwise damaged...			
Color.....	{	Dark amber.....			
		Amber			
		Light amber.....			
		Yellowish			
		White			
		Off color.....			
Texture.....	{	Hard			
		Medium			
		Soft			
Size.....	{	Large			
		Medium			
		Small			

- (1) What is meant by the term "texture" as applied to wheat kernels?
- (2) Has texture any relation to hardness?
- (3) Has texture any relation to the composition of the kernel?
- (4) How may weather conditions affect the texture?
- (5) Do soils have any effect upon texture and hardness of the kernels produced?
- (6) Why does the miller prefer plump kernels for milling purposes?
- (7) Why does the miller object to wheat that is badly bleached?
- (8) Describe a good milling wheat.

EXERCISE 19.

DATE

EXPLANATION OF SCORE CARD FOR WHEAT.

1. Weight per bushel — 25.

Wheat should weigh sixty pounds per measured bushel. Cut two points for each pound below this.

2. Soundness — 20.

There should be no sprouted, cracked, smutty, musty, bin-burned, or otherwise damaged grains in the sample. Cut two points for each per cent of unsound grains.

3. Purity — 10.

The sample should be free from mixture or foreign matter of any kind. Cut one point for each percent of foreign matter.

4. Plumpness — 15.

The grains should be well filled and plump. Cut one point for each two percent of shriveled grains.

5. Uniformity in hardness and texture — 15.

The berries should be uniform in hardness and texture. In a lot of 100 grains determine three classes, (1) grains hard and vitreous, (2) grains soft and starchy, (3) grains intermediate.

Cut one point for each three per cent representing class 2 and one point for each ten per cent in class 3. In a fairly uniform sample two classes only may be distinguished.

6. Uniformity in color — 10.

Cut one point for each three per cent not uniform in color with the bulk of the sample. Consider "yellow berry" as a discoloration.

7. Uniformity in size — 5.

Cut one point for each four per cent of undersized grains.

EXERCISE 19.

DATE

SCORE CARD FOR WHEAT.

Sample number.....						
Weight per bushel..... 25	.....	.....	.....	.....	.....	.....
Soundness 20	.....	.....	.....	.....	.....	.....
Purity 10	.....	.....	.....	.....	.....	.....
Plumpness 15	.....	.....	.....	.....	.....	.....
Uniformity in —						
Hardness and texture..... 15	.....	.....	.....	.....	.....	.....
Color 10	.....	.....	.....	.....	.....	.....
Size of kernels..... 5	.....	.....	.....	.....	.....	.....
Total 100	.....	.....	.....	.....	.....	.....

Sample number.....						
Weight per bushel..... 25	.....	.....	.....	.....	.....	.....
Soundness 20	.....	.....	.....	.....	.....	.....
Purity 10	.....	.....	.....	.....	.....	.....
Plumpness 15	.....	.....	.....	.....	.....	.....
Uniformity in —						
Hardness and texture..... 15	.....	.....	.....	.....	.....	.....
Color 10	.....	.....	.....	.....	.....	.....
Size of kernels..... 5	.....	.....	.....	.....	.....	.....
Total 100	.....	.....	.....	.....	.....	.....

Remarks and reasons for cuts:

EXERCISE 20.

DATE

MARKET CLASSES OF WHEAT.

Preliminary to practice in the grading of wheat each student should make a close study of typical kernels of each of the different classes. This study should fix in his mind the characteristics of each class and enable him to distinguish between them. After a close comparative study of the different classes, give in the following outline a brief, concise description of each class, noting the characteristics that will be of assistance in identification.

Red Winter.....

.....

.....

.....

Hard Winter.....

.....

.....

Hard Spring.....

.....

.....

Spring

.....

.....

Durum

.....

.....

Pacific Coast.....

.....

.....

White Spring.....

.....

.....

.....

EXERCISE 21.

DATE

OATS.

(Label all parts of each drawing.)

- (1) Make a drawing of an open panicle of oats showing:
 - (1) Rachis
 - (2) Branches
 - (3) Pedicel
 - (4) Spikelets
- (2) Make a drawing of a single spikelet showing:
 - (1) Outer glume
 - (2) Two oat grains
 - (3) Awn (if present)
 - (4) Sterile flower
- (3) Make a drawing of a cross section of a single oat grain showing:
 - (1) Flowering glume
 - (2) Palea
 - (3) Kernel
 - (4) Suture
- (4) Make a drawing of a longitudinal section of the oat kernel, showing:
 - (1) Covering
 - (2) Endosperm
 - (3) Germ.
- (5) Weight of 25 upper grains..... ..25 lower grains
- (6) What is the difference between a spike and a panicle?
- (7) How many branches in the first whorl? Second?
- (8) Is there any variation in the length of the pedicel?
- (9) Compare the outer glume of oats with the same of wheat.
- (10) Compare the flowering glume and palea of oats with the same of wheat.
- (11) Locate the germ in the oat kernel.
- (12) What is an open panicle? Compressed panicle? Side panicle?
- (13) How does the oat grain differ from the wheat grain? How does the oat kernel differ from the wheat grain?

EXERCISE 22.

DATE

COMPARATIVE STUDY OF OAT VARIETIES.

(Laboratory.)

Study a number of varieties of oats according to the following outline. Each student is provided with several panicles of the varieties to be studied. The members of the class work in groups of two, combining data where averages are required.

Variety.			
I. Panicle —			
1. Length (average of 5) (lower whorl to tip of upper spikelet)			
2. Shape (open, medium, compressed, side)			
3. Number of whorls (average of 5)			
4. Number of branches in all whorls (average of 5)			
II. Spikelet —			
1. Number in panicle (average of 5)			
2. Number of grains per spikelet			
3. Length of pedicels (average of 10)			
4. Color of outer glume (white, yellow, etc.)			
5. Number of sterile spikelets			
III. Grain —			
1. Length (long, medium, short)			
2. Plumpness (plump, medium, slender)			
3. Color (white, gray, yellow, brown, red, black)			
4. Length of awn (long, medium, short, none)			
5. Per cent of hull			

1. Note distinguishing characters of the varieties studied.
2. What factors influence the percent of hull in oats? What is the common percentage of hull?
3. What factors may influence the amount of grain on the oat panicle?
4. What factors would govern your selection of panicles in the field for breeding or seed purposes?
5. Is there any correlation between weight and plumpness of grain? Between yield and plumpness of grain?
6. What physical characters of oat grains may be associated with a heavy weight per bushel?
7. Is there any relation between shape of panicle and yield?

EXERCISE 23.

DATE

VARIETY STUDY OF OATS IN THE FIELD

(Four or five weeks from date of seeding.)

Variety.					
Vigor .....	.....	.....	.....	.....	.....
Stand .....	.....	.....	.....	.....	.....
Color of foliage.....	.....	.....	.....	.....	.....
General appearance.....	.....	.....	.....	.....	.....
No. of plants per rod...	.....	.....	.....	.....	.....
Calculated plants per acre.....	.....	.....	.....	.....	.....
No. of culms per plant.....	.....	.....	.....	.....	.....
No. of culms per acre (calculated)	.....	.....	.....	.....	.....

(In noting vigor, stand and general appearance, base the marking on 100 as perfect..)

Write up a report of the exercise giving reference to the important variations that came to your attention.

EXERCISE 24.

DATE

OAT JUDGING. A DETAILED STUDY OF OATS.

Obtain 10 gram samples of good and poor grades of oats, and separate each according to the accompanying outline. (p. 40.) Weigh the foreign matter, if possible, either weigh or count the materials in the other items studied and record results in percent.

Purity.

Determine the number of oat grains in the sample that compose the oats of the class (i. e., white, red, etc.) represented by the sample. Likewise, determine the amount of impurities as represented by "other oats," "other grains," and foreign matter. Wheat, rye, barley, etc., are examples of other grain. All dirt, chaff, weed seeds, etc., etc., constitute the foreign matter. The total for purity should be 100 per cent.

Soundness.

Discard the foreign matter and other grain, and determine soundness by dividing the remainder of the sample into sound and unsound lots. Sound oats should have a bright color. Unsound oats may be dull in color, bleached, moldy, sprouted, etc. The total for soundness should be 100 percent.

Color.

Separate the sample into the different colors that can be found. The total for color should be 100 percent.

Plumpness.

Determine the percent of grains that are plump, those that are medium in plumpness, and of those that are slender. The total for plumpness should be 100 percent.

Record the weight per bushel.

OAT JUDGING—DETAILED STUDY.

No. of sample or variety.						
Purity.....	{ Oats of class.....					
	{ Other oats.....					
	{ Other grain.....					
	{ Foreign matter.....					
Soundness....	{ Sound grains.....					
	{ Unsound grains.....					
Color.....	{ White					
	{ Gray					
	{ Yellow					
	{ Brown					
	{ Red					
	{ Black					
Plumpness....	{ Plump					
	{ Medium					
	{ Slender					
Size.....	{ Large					
	{ Medium					
	{ Small					
Weight per bushel.....						

EXERCISE 25.

DATE

SCORING OATS.

EXPLANATION OF SCORE CARD FOR OATS.

In this score card oats are judged principally from the market standpoint. It is not possible to make a score card by which an oat could be judged at the same time from both the feeder's and the miller's standpoint, and also be used to judge the grain for seed. Different points would be used in each case, and different values given them.

Weight per Bushel — 35 points.

Weight per bushel is important as a means of estimating the value of an oat for market and feeding as well, since a heavy weight indicates that the grain was well matured and the hull well filled out. In the same variety a heavy oat usually has a smaller per cent of hull. A good sample of oats should weigh 32 pounds per measured bushel.

Cut four points for each pound below standard weight. For each pound above standard weight add one point to the total score.

Soundness—20 points.

The sample should be sound, dry, bright, and free from musty, smutted, sprouted, or otherwise damaged grains. Cut one point for each percent of damaged grains.

Color—15 points.

The color of the grains should be bright and uniform for the bulk of the sample.

Cut one point for each per cent of discolored grains and grains not uniform in color with the bulk of the sample.

Purity—10 points.

The sample should be free from mixture, other grain, weed seeds, straw, chaff, and any other foreign matter of any kind.

Cut one point for each per cent of mixture and the same for each percent of foreign matter.

Per Cent of Hull—20 points.

A good oat may have as much as 30 per cent. of hull.

Cut two points for each percent of hull above this. For each percent below add one point to the total score.

SCORE CARD FOR OATS.

Sample No.....						
Weight per bushel..... 35	.....	.....	.....	.....	.....	.....
Soundness 20	.....	.....	.....	.....	.....	.....
Color 15	.....	.....	.....	.....	.....	.....
Purity 10	.....	.....	.....	.....	.....	.....
Per cent of hull..... 20	.....	.....	.....	.....	.....	.....
Total 100	.....	.....	.....	.....	.....	.....

Sample No.....						
Weight per bushel..... 35	.....	.....	.....	.....	.....	.....
Soundness 20	.....	.....	.....	.....	.....	.....
Color 15	.....	.....	.....	.....	.....	.....
Purity 10	.....	.....	.....	.....	.....	.....
Per cent of hull..... 20	.....	.....	.....	.....	.....	.....
Total 100	.....	.....	.....	.....	.....	.....

Remarks and reasons for cuts:

EXERCISE 26.

DATE

TREATMENT OF SEED OATS FOR SMUT.

THE FORMALIN TREATMENT.

Calculate the volume of formalin (40% solution of formaldehyde gas in water) required to treat one bushel of oats, if one pint of formalin in 50 gallons of water will be sufficient to treat about 50 bushels of seed oats.

Spread the oats to be treated on a clean tight floor, and apply the treating solution by means of a sprinkling can. During application, shovel the oats about, so that a uniform application may be given. The oats should be well moistened, but not so much that they will pack when pressed in the hands. Shovel the oats into a pile and cover them with sacks for from 2 to 4 hours. At the end of this time remove the sacks and dry the treated seed as rapidly as possible.

Write up a report, giving the life history and the economic importance of the loose smut of oats (*Ustilago Avenae* (Pers) Jens.) Give another method for the treatment of seed oats for smut.

References: Fungous Diseases of plants. B. M. Duggar. Farmers' Bul. 507 (1912)—The Smuts of Wheat, Oats and Barley.

EXERCISE 27.

DATE

BARLEY.

(Label all parts in each drawing.)

- I. Make drawing of barley spike:
 - (a) Two rowed
 - (b) Six rowed.
- II. Remove all the spikelets but one on a two rowed spike.
Draw a front view, showing how the spikelet is attached.
 - (b) Draw the same view for the six rowed type, but showing three spikelets from the same node in place.
- III. Draw side view of rachis with one spikelet in position :
- IV. (a) Draw a spikelet of the six rowed type; (front view).
(b) Draw three spikelets of the six rowed type; (front view).
- V. Make longitudinal section of spikelet showing :
Outer glume
Flowering glume
Kernel
Palea
- VI. Compare a spike of wheat with a spike of barley. Compare the outer glumes; flowering glumes; kernel; palea.
- VII. Compare a spikelet of wheat with a spikelet of barley.
- VIII. (a) Explain differences of two rowed and six rowed barley.
(b) Of four rowed and six rowed.

EXERCISE 28.

DATE

VARIETY STUDY OF BARLEY IN THE LABORATORY.

Variety.				
I. Spike—				
1. Length (average of 5).....				
2. Shape (tapering toward tip, or both ways, uniform)				
3. Awn (bearded, partly bearded, beardless) ..				
4. Length of awn (average of 5 spikes).....				
5. Persistence of awn (deciduous, partly de- ciduous, persistent).....				
6. Compactness (very open, open, medium, crowded)				
7. Color (whitish, yellowish, brownish, black) ..				
II. Spikelet—				
1. Shape (wide, medium, narrow).....				
2. Outer glume (awned, awn-pointed, awnless) ..				
3. Number of grains per spikelet (average of 5 spikes).....				
4. Number of grains per spike (average of 5 spikes)				
5. Number of sterile flowers (average of 5 spikes)				
III. Grain—				
1. Hulled or hullless.....				
2. Size				
(1) Weight of 100 grains.....				
*(2) Average length of 10 grains.....				
(3) Average width of 10 grains.....				
3. Plumpness (thin, medium, plump).....				
4. Crease (deep, medium, full).....				
5. Texture (hard, medium, soft and starchy) ..				
6. Color (white, yellow, brown, purple, black) ..				

*Use coördinate paper, page 50.

EXERCISE 29.

DATE

BARLEY JUDGING—DETAILED STUDY*

No. of Sample.					
Purity.....	{ Barley of class.....	.....	.....	.....	.....
	{ Other grain.....	.....	.....	.....	.....
	{ Foreign matter.....	.....	.....	.....	.....
Soundness...	{ Sound .....	.....	.....	.....	.....
	{ Cracked .....	.....	.....	.....	.....
	{ Sprouted .....	.....	.....	.....	.....
	{ Bin burnt, decayed, etc..	.....	.....	.....	.....
Color.....	{ Good color.....	.....	.....	.....	.....
	{ Partly discolored.....	.....	.....	.....	.....
	{ Badly discolored.....	.....	.....	.....	.....
Texture.....	{ Vitreous .....	.....	.....	.....	.....
	{ Medium .....	.....	.....	.....	.....
	{ Starchy .....	.....	.....	.....	.....
Size.....	{ Large .....	.....	.....	.....	.....
	{ Medium .....	.....	.....	.....	.....
	{ Small .....	.....	.....	.....	.....
Weight, 100 grains.....		.....	.....	.....	.....
Uniformity of grains.....		.....	.....	.....	.....

*Before beginning this exercise read carefully the notes on explanation of score card for barley.

EXERCISE 30.

DATE

JUDGING BARLEY BY MEANS OF THE SCORE CARD.

EXPLANATION OF SCORE CARD FOR BARLEY.

Barley is judged from the brewer's standpoint, rather than from its feeding value, since the market price is based on its brewing quality. A different score card would be used to judge barley according to its feeding value, for the latter may be more unsound and less uniform than the former.

Weight per bushel — 10 points.

Other things being the same, the barley with the heaviest weight per bushel is preferred, since weight is accompanied by a high percent of extract. Barley should weigh 48 pounds per bushel. A high weight should not be caused by excessive moisture.

Cut one point for each pound below this.

Soundness — 30 points.

The sample should be free from discolored, sprouted, bin-burned, decayed, cracked or otherwise damaged grains. It should not be musty, but have a sweet odor.

Cut one point for each unsound or damaged grain, and for mustiness according to judgment.

Foreign Matter — 10 points.

The sample should be free from other grains, grass, and weed seeds, as such impurities cause irregularity in germination and an unfavorable ferment.

Estimate the percent of foreign matter by weight, and cut one point for each percent.

Uniformity in color — 15 points.

Separate the sample into various classes according to color. Let the class having the largest number determine the color of the sample. Cut one point for each percent representing the other classes.

Uniformity in Texture — 20 points.

The texture of the sample should be uniformly hard or soft. Determine the class represented by the largest number and cut one point for each percent of grains in the other class.

Uniformity in size — 10 points.

The grains should all be of the same size, as different sizes cause irregular germination. Divide the sample into large and small sizes, and cut one point for each two percent representing the smaller class.

EXERCISE 30.

DATE

SCORE CARD FOR BARLEY.

Variety or sample number.					
Weight per bushel..... 10	.....	.....	.....	.....	.....
Soundness 30	.....	.....	.....	.....	.....
Foreign matter.....	.....	.....	.....	.....	.....
Uniformity in color..... 15	.....	.....	.....	.....	.....
Uniformity in texture..... 20	.....	.....	.....	.....	.....
Uniformity in size..... 15	.....	.....	.....	.....	.....
Total .....	.....	.....	.....	.....	.....

Remarks:

EXERCISE 31.

DATE

RYE.

(Label all parts in each drawing.)

1. Make a drawing of a rye spike.
2. Make a drawing of a spikelet.
3. Dissect a spikelet, and make a detailed drawing of each part.
4. Make a brief comparison of a rye spikelet with the same of wheat.

SCORE CARD FOR RYE.

Sample No.....					
Weight per bushel..... 60	.....	.....	.....	.....	.....
Color 25	.....	.....	.....	.....	.....
Foreign matter..... 15	.....	.....	.....	.....	.....

EXERCISE 32.

DATE

COMPARISON OF THE HEAD OF OATS, WHEAT, BARLEY, RYE
AND EMMER.

- I. Make a drawing of a spikelet of oats, wheat, rye, two rowed and six rowed barley. (See note below.)
- II. Make a drawing of the flowering glume of each of the above, including either two or six rowed barley. (See note below.)
- III. Make a drawing of the flowering glume of each of the above, showing the attachment of the awn in each case. (See note below.)
- IV. Make a drawing or diagram showing the relative size and location of the palea of each of the above. (See note below.)
- V. Define: sessile, rachis, rachella, pedicel, spike and panicle.
- VI. Make a drawing of a head of each of the above.
(Make the drawings of the same part of each head on the same page when possible. Enlarge each drawing six times.)

SCALE 1/10 OF ONE INCH.

1

2

3

4

5

6

7

1

2

3

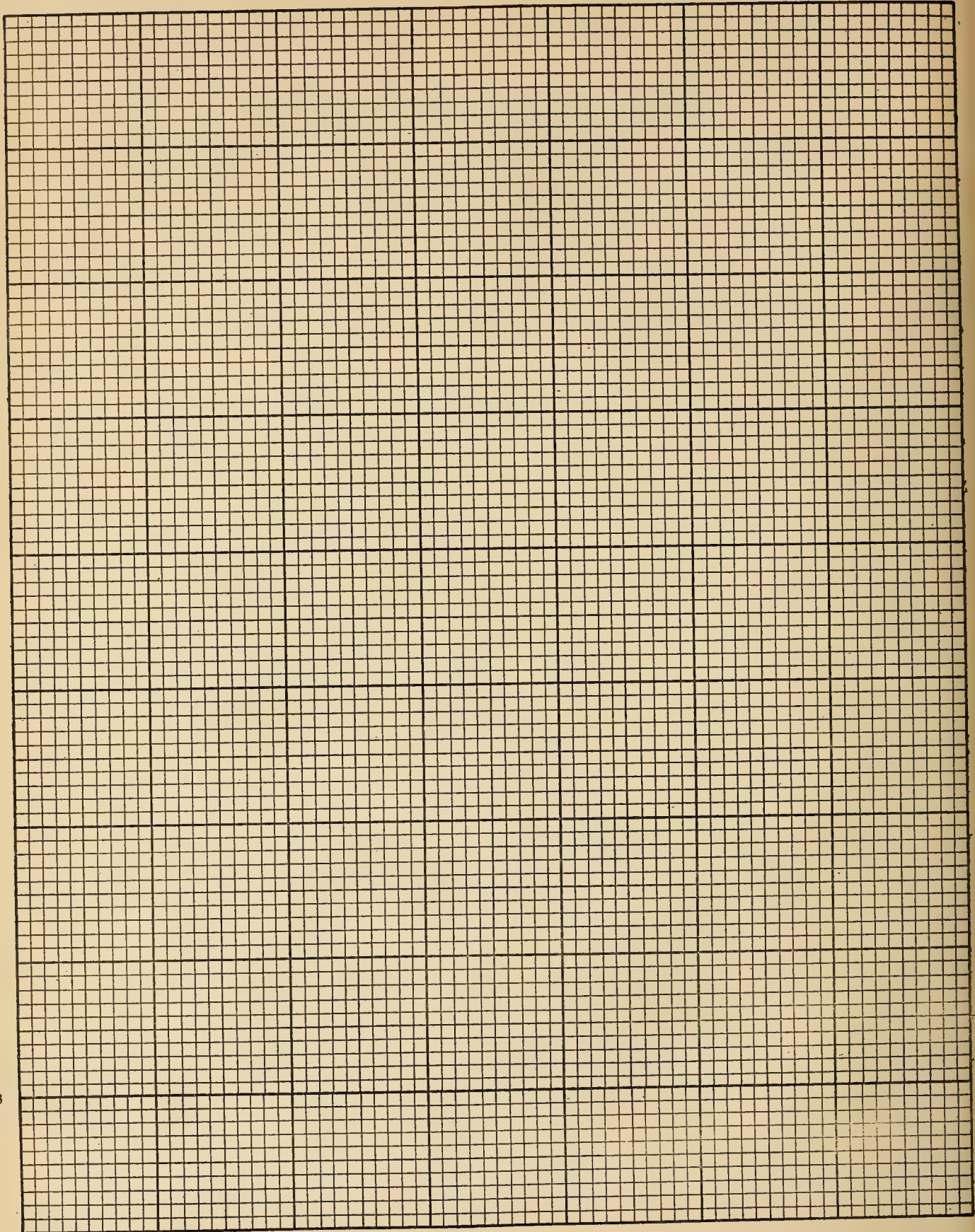
4

5

6

7

8



GRADES OF GRAIN

Adopted and promulgated by the
GRAIN DEALERS NATIONAL ASSOCIATION.

SAMPLE GRADES—GENERAL RULE

All wheat, barley, oats, rye and corn that is in a heated condition, souring, or too damp to be safe for warehousing, or that is badly bin-burnt, fire-burnt, fire-smoked, or badly damaged, mixed with garlic, onions, or containing live weevil, exceedingly dirty, or where different kinds of grain are badly mixed with one another, shall be classed as Sample Grade, and the inspector shall make notations as to quality and condition.

NOTICE.—The inspection departments shall, in no case, make a grade of grain above that of the poorest quality found in any lot of grain inspected, when it has evidently been plugged for the purpose of deception, or otherwise improperly loaded. Wheat which has been subjected to scouring, or clipping, or any process equivalent thereto, shall not be graded higher than a 3.

NEW.

The word "NEW" shall be inserted in each certificate of inspection of a newly harvested crop of oats until the fifteenth day of August; of rye, until the first day of September; of wheat, until the first day of November; and of barley, until the first day of November of each year.

This change shall be construed as establishing new grades for the times specified, to conform to the existing grades of grain in all particulars, except the distinctions hereby established between the new and the old crop, and shall apply to grain inspected from store for two months after the time respectively above specified.

Manner of Testing Grain with a Testing Kettle

Place the kettle where it cannot be jarred or shaken. Pour from a scoop, bag or pan, held two inches from the top of the kettle, into the middle of the kettle at a moderate speed until running over. Strike off in a zigzag manner with the edge of the beam held horizontally.

Recommended by the Chief Grain Inspectors National Association.

E. H. CULVER,
President.

Corn

The following maximum limits shall govern all inspection and grading of corn:

<i>Grade.</i>	<i>Percentage of Moisture.</i>	<i>Percentage cob rotten. Exclusive of bin burnt or mahogany corn.</i>	<i>Percentage dirt and broken grains.</i>
1.	15	1	1
2.	16	5	2
3.	19	10	4
4.	22		See No. 4 Corn rule, all colors.

White Corn**NO. 1 WHITE CORN**

Shall be 99 per cent. white, sweet and well matured.

NO. 2 WHITE CORN

Shall be 98 per cent. white and sweet.

NO. 3 WHITE CORN

Shall be 98 per cent. white and sweet.

NO. 4 WHITE CORN

Shall be 98 per cent. white; but shall include damp, damaged, or musty corn.

Yellow Corn**NO. 1 YELLOW CORN**

Shall be 99 per cent. yellow, sweet and well matured.

NO. 2 YELLOW CORN

Shall be 95 per cent. yellow and sweet.

NO. 3 YELLOW CORN

Shall be 95 per cent. yellow and sweet.

NO. 4 YELLOW CORN

Shall be 95 per cent. yellow; but shall include damp, damaged, or musty corn.

Mixed Corn**NO. 1 MIXED CORN**

Shall be corn of various colors sweet and well matured.

NO. 2 MIXED CORN

Shall be corn of various colors and sweet.

NO. 3 MIXED CORN

Shall be corn of various colors and sweet.

NO. 4 MIXED CORN

Shall be corn of various colors; but shall include damp, damaged or musty corn.

GRADES OF WHEAT**White Winter Wheat****NO. 1 WHITE WINTER WHEAT**

Shall include all varieties of pure soft white winter wheat, sound, plump, dry, sweet and clean, and weigh not less than 58 lbs. to the measured bushel.

NO. 2 WHITE WINTER WHEAT

Shall include all varieties of soft white winter wheat, dry, sound and clean, and shall not contain more than 8 per cent. of soft red winter wheat, and weigh not less than 56 lbs. to the measured bushel.

NO. 3 WHITE WINTER WHEAT

Shall include all varieties of soft white winter wheat. It may contain 5 per cent. of damaged grains other than skin-burnt wheat, and may contain 10 per cent. of soft red winter wheat, and weigh not less than 53 lbs. to the measured bushel.

NO. 4 WHITE WINTER WHEAT

Shall include all varieties of soft white winter wheat not fit for a higher grade in consequence of being poor quality, damp, musty or dirty, and shall not contain more than 10 per cent. of soft red winter wheat, and weigh not less than 50 lbs. to the measured bushel.

Red Winter Wheat

NO. 1 RED WINTER WHEAT

Shall be pure soft red winter wheat of both light and dark colors, sound, sweet, plump and well cleaned, and weigh not less than 60 lbs. to the measured bushel.

NO. 2 RED WINTER WHEAT

Shall be soft red winter wheat of both light and dark colors, sound, sweet and clean, shall not contain more than 5 per cent. of white winter wheat, and weigh not less than 58 lbs. to the measured bushel.

NO. 3 RED WINTER WHEAT

Shall be sound, soft red winter wheat not clean or plump enough for No. 2, shall not contain more than 8 per cent. of white winter wheat, and weigh not less than 55 lbs. to the measured bushel.

NO. 4 RED WINTER WHEAT

Shall be soft red winter wheat, shall contain not more than 8 per cent. of white winter wheat. It may be damp, musty or dirty, but must be cool, and weigh not less than 50 lbs. to the measured bushel.

Hard Winter Wheat

NO. 1 HARD WINTER WHEAT

Shall include all varieties of pure, hard winter wheat, sound, plump, dry, sweet and well cleaned and weigh not less than 61 lbs. to the measured bushel.

NO. 2 HARD WINTER WHEAT

Shall include all varieties of hard winter wheat of both light and dark colors, dry, sound, sweet and clean, and weigh not less than 59 lbs. to the measured bushel.

NO. 3 HARD WINTER WHEAT

Shall include all varieties of hard winter wheat of both light and dark colors, not clean or plump enough for No. 2, and weigh not less than 56 lbs. to the measured bushel.

NO. 4 HARD WINTER WHEAT

Shall include all varieties of hard winter wheat of both light and dark colors. It may be damp, musty or dirty, and weigh not less than 50 lbs. to the measured bushel.

Northern Spring Wheat**NO. 1 HARD SPRING WHEAT**

Shall be sound, bright, sweet, clean, and consist of over 50 per cent. of the hard Scotch Fife, and weigh not less than 58 lbs. to the measured bushel.

NO. 1 NORTHERN SPRING WHEAT

Must be Northern grown spring wheat, sound, clean, and of good milling quality and must contain not less than 50 per cent. of the hard varieties of spring wheat, and weigh not less than 57 lbs. to the measured bushel.

NO. 2 NORTHERN SPRING WHEAT

Shall be Northern grown spring wheat, not clean enough or sound enough for No. 1 and must contain not less than 50 per cent. of the hard varieties of spring wheat and must weigh not less than 56 lbs. to the measured bushel.

NO. 3 NORTHERN SPRING WHEAT

Shall be composed of inferior shrunken Northern grown spring wheat, and weigh not less than 54 lbs. to the measured bushel, and must contain not less than 50 per cent. of the hard varieties of spring wheat.

NO. 4 NORTHERN SPRING WHEAT

Shall include all inferior Northern grown spring wheat that is badly shrunken or damaged and must contain not less than 50 per cent. of the hard varieties of spring wheat, and shall weigh not less than 49 lbs. to the measured bushel.

Spring Wheat**NO. 1 SPRING WHEAT**

Shall be sound, plump and well cleaned, and weigh not less than 59 lbs. to the measured bushel.

NO. 2 SPRING WHEAT

Shall be sound, clean, of a good milling quality and weigh not less than $57\frac{1}{2}$ lbs. to the measured bushel.

NO. 3 SPRING WHEAT

Shall include all inferior, shrunk or dirty spring wheat, and weigh not less than 53 lbs. to the measured bushel.

NO. 4 SPRING WHEAT

Shall include all spring wheat damp, musty, grown, badly bleached, or from any cause which renders it unfit for No. 3 and weigh not less than 49 lbs. to the measured bushel.

White Spring Wheat**WHITE SPRING WHEAT.**

The grades of Nos. 1, 2, 3 and 4 White Spring Wheat shall correspond with the grades of Nos. 1, 2, 3 and 4 Spring Wheat, except that they shall be of the white variety.

Durum [Macaroni] Wheat**NO. 1 DURUM WHEAT**

Shall be bright, sound, dry, well cleaned and be composed of durum, commonly known as macaroni wheat, and weigh not less than 60 lbs. to the measured bushel.

NO. 2 DURUM WHEAT

Shall be dry, clean, and of good milling quality. It shall include all durum wheat that for any reason is not suitable for No. 1 durum, and weigh not less than 58 lbs. to the measured bushel.

NO. 3 DURUM WHEAT

Shall include all durum wheat bleached, shrunk, or for any cause unfit for No. 2, and weigh not less than 55 lbs. to the measured bushel.

NO. 4 DURUM WHEAT

Shall include all durum wheat that is badly bleached or for any cause unfit for No. 3, and weigh not less than 50 lbs. to the measured bushel.

Pacific Coast Wheat

NO. 1 PACIFIC COAST RED WHEAT

Shall be dry, sound, clean and free from smut and weigh not less than 59 lbs. to the measured bushel.

NO. 2 PACIFIC COAST RED WHEAT

Shall be dry, sound, clean and only slightly tainted with smut and alkali, and weigh not less than 58 lbs. to the measured bushel.

NO. 3 PACIFIC COAST RED WHEAT

Shall include all other Pacific Coast red wheat. It may be smutty or musty, or from any other reason unfit for flouring purposes, and weigh not less than 54 lbs. to the measured bushel.

NOTE:

Pacific Coast White Wheat shall be graded according to the rules for Pacific Coast Red Wheat. In case of a mixture of Pacific Coast wheat with our home grown wheat, red or white, such mixture shall be graded "Pacific Coast Mixed Wheat."

NOTE:

The grades of Pacific White and Pacific Red Wheat are to include all such wheats as are grown in the extreme Northwest and on the Pacific slope from either Spring or Winter seeding.

Mixed Wheat

MIXED WHEAT

In case of an appreciable mixture of hard and soft wheat, red and white wheat (except as provided in the rule of red winter, white winter and northern spring wheat), durum, and spring wheat any of them with each other, it shall be graded according to the quality thereof, and the kind of wheat predominating, shall be classed as No. 1, 2, 3 and 4 mixed wheat, and the inspector shall make notation describing its character.

GRADES OF OATS

White Oats

NO. 1 WHITE OATS

Shall be white, dry, sweet, sound, bright, clean, free from other grain and weigh not less than 32 lbs. to the measured bushel.

NO. 2 WHITE OATS

Shall be 95 per cent. white, dry, sweet, shall contain not more than 1 per cent. of dirt and 1 per cent. of other grain, and weigh not less than 29 lbs. to the measured bushel.

STANDARD WHITE OATS

Shall be 92 per cent. white, dry, sweet, shall not contain more than 2 per cent. of dirt and 2 per cent. of other grain, and weigh not less than 28 lbs. to the measured bushel.

NO. 3 WHITE OATS

Shall be sweet, 90 per cent. white, shall not contain more than 3 per cent. of dirt and 5 per cent. of other grain, and weigh not less than 24 lbs. to the measured bushel.

NO. 4 WHITE OATS

Shall be 90 per cent. white, may be damp, damaged, musty or very dirty.

NOTICE:

Yellow Oats shall not be graded better than No. 3 white oats.

Mixed Oats**NO. 1 MIXED OATS**

Shall be oats of various colors, dry, sweet, sound, bright, clean, free from other grain and weigh not less than 32 lbs. to the measured bushel.

NO. 2 MIXED OATS

Shall be oats of various colors, dry, sweet, shall not contain more than 2 per cent. of dirt and 2 per cent. of other grain, and weigh not less than 28 lbs. to the measured bushel.

NO. 3 MIXED OATS

Shall be sweet oats of various colors, shall not contain more than 3 per cent. of dirt and 5 per cent. of other grain, and weigh not less than 24 lbs. to the measured bushel.

NO. 4 MIXED OATS

Shall be oats of various colors, damp, damaged, musty or very dirty.

Red or Rust Proof Oats**NO. 1 RED OATS OR RUST PROOF**

Shall be pure red, sound, bright, sweet, clean and free from other grain and weigh not less than 32 lbs. to the measured bushel.

NO. 2 RED OATS OR RUST PROOF

Shall be seven-eighths red, sweet, dry, and shall not contain more than two per cent. dirt or foreign matter, and weigh 30 lbs. to the measured bushel.

NO. 3 RED OATS OR RUST PROOF

Shall be sweet, seven-eighths red, shall not contain more than five per cent. dirt or foreign matter and weigh not less than 24 lbs. to the measured bushel.

NO. 4 RED OATS OR RUST PROOF

Shall be seven-eighths red, may be damp, musty, or very dirty.

White Clipped Oats**NO. 1 WHITE CLIPPED OATS**

Shall be white, clean, dry, sweet, sound, bright, free from other grain, and weigh not less than 35 lbs. to the measured bushel.

NO. 2 WHITE CLIPPED OATS

Shall be 95 per cent. white, dry, sweet, shall not contain more than 2 per cent. of dirt or foreign matter and weigh not less than 32 lbs. to the measured bushel.

NO. 3 WHITE CLIPPED OATS

Shall be sweet, 90 per cent. white, shall not contain more than 5 per cent. of dirt or foreign matter, and weigh not less than 30 lbs. to the measured bushel.

NO. 4 WHITE CLIPPED OATS

Shall be 90 per cent. white, damp, damaged, musty or dirty, and weigh not less than 30 lbs. to the measured bushel.

Mixed Clipped Oats

NO. 1 MIXED CLIPPED OATS

Shall be oats of various colors, dry, sweet, sound, bright, clean, free from other grain, and weigh not less than 35 lbs. to the measured bushel.

NO. 2 MIXED CLIPPED OATS

Shall be oats of various colors, dry, sweet, shall not contain more than 2 per cent. of dirt or foreign matter, and weigh not less than 32 lbs. to the measured bushel.

NO. 3 MIXED CLIPPED OATS

Shall be sweet oats of various colors, shall not contain more than 5 per cent. of dirt or foreign matter, and weigh not less than 30 lbs. to the measured bushel.

NO. 4 MIXED CLIPPED OATS

Shall be oats of various colors, damp, damaged, musty or dirty and weigh not less than 30 lbs. to the measured bushel.

NOTE

Inspectors are authorized when requested by shippers, to give weight per bushel instead of grade on Clipped White Oats and Clipped Mixed Oats from private elevators.

Purified Oats

PURIFIED OATS

All oats that have been chemically treated or purified, shall be classed as purified oats, and inspectors shall give the test weight on each car or parcel, that may be so inspected.

GRADES OF BARLEY

(Note.—These Barley Rules have been adopted by the Barley Association of the United States.)

NO. 1 BARLEY

Shall be sound, plump, bright, clean and free from other grain, and, not scoured nor clipped, shall weigh not less than 48 lbs. to the measured bushel.

NO. 2 BARLEY

Shall be sound, of healthy color (bright or straw color), reasonably clean and reasonably free from other grains and seeds, and, not scoured nor clipped, shall weigh not less than 46 lbs. to the measured bushel.

NO. 3 BARLEY

Shall include slightly shrunken or otherwise slightly damaged barley, not good enough for No. 2, and, not scoured nor clipped, shall weigh not less than 44 lbs. to the measured bushel.

NO. 4 BARLEY

Shall include barley fit for malting purposes, not good enough for No. 3.

NO. 1 FEED BARLEY

Shall test not less than 40 lbs. to the measured bushel, shall be cool and reasonably free from other grain and seeds, and not good enough for No. 4, and may include barley with a strong ground smell, or a slightly musty or bin smell.

REJECTED BARLEY

Shall include all barley testing under 40 lbs. to the measured bushel, or barley which is badly musty or badly damaged, and not good enough to grade "feed" barley, except that barley which has been chemically treated shall not be graded at all.

BAY BREWING BARLEY

The grades of Nos. 1, 2 and 3 Bay Brewing Barley shall conform in all respects to the grades of Nos. 1, 2 and 3 barley, except that they shall be of the Bay Brewing variety, grown in the far west and on the Pacific Coast.

CHEVALIER BARLEY

The grades of Nos. 1, 2 and 3 Chevalier barley shall conform in all respects to the grades of Nos. 1, 2 and 3 barley, except that they shall be of the Chevalier variety grown in the far west and on the Pacific Coast.

BAY BREWING MIXED BARLEY

In case of admixture of Bay Brewing barley with barley of other varieties, it shall be graded according to the quality thereof and classed as 1-2-3 Bay Brewing Mixed Barley.

CHEVALIER MIXED BARLEY

In case of admixture of Chevalier barley with barley of other varieties, it shall be graded according to the quality thereof and classed as 1-2-3 Chevalier Mixed Barley.

Winter Barley**NO. 1 WINTER BARLEY**

Shall be plump, bright, sound and clean, free from other grain, and weigh not less than 48 lbs. to the measured bushel.

NO. 2 WINTER BARLEY

Shall be sound, plump, may be stained, shall contain not more than 3 per cent. of foreign matter, and weigh not less than 46 lbs. to the measured bushel.

NO. 3 WINTER BARLEY

Shall include all shrunken, stained and dirty barley, shall contain not more than 5 per cent. of foreign matter, and weigh not less than 44 lbs. to the measured bushel.

NO. 4 WINTER BARLEY

Shall include all barley not fit for a higher grade in consequence of being poor quality, damp, musty or dirty; shall contain not more than 10 per cent. of foreign matter and weigh not less than 40 lbs. to the measured bushel.

GRADES OF RYE**NO. 1 RYE**

Shall be dry, sound, plump, sweet and well cleaned and shall weigh not less than 57 lbs. to the measured bushel.

NO. 2 RYE

Shall be dry, sound and contain not more than 1 per cent. of other grain or foreign matter, and weigh not less than 55 lbs. to the measured bushel.

NO. 3 RYE

Shall include inferior rye not unsound, but from any other cause not good enough for No. 2, and weigh not less than 53 lbs. to the measured bushel.

NO. 4 RYE

May be damp, musty or dirty, and weigh not less than 50 lbs. to the measured bushel.

EXERCISE 36.

DATE

STUDY OF LEGUME SEEDS.

(Clovers, Alfalfa, Etc.)

Make a careful drawing of one of each of the different kinds of seeds supplied for the exercise. When there is more than one characteristic shape for the seed of any one legume, make a drawing of each type. Enlarge the drawing six or seven times. Label all parts in each drawing. After completing the drawings, write up a full description of each kind of seed, giving special attention to any characteristics that are helpful in identification. The following characters should be noted carefully: Size, shape, color, prominence of radicle, length of radicle, and prominence of hilum.

REFERENCES:—

Farmers' Bulletin	No. 428.
Minnesota Station Bulletin.....	127.
Michigan Station Bulletin.....	260.
Ohio Station Bulletin.....	175.

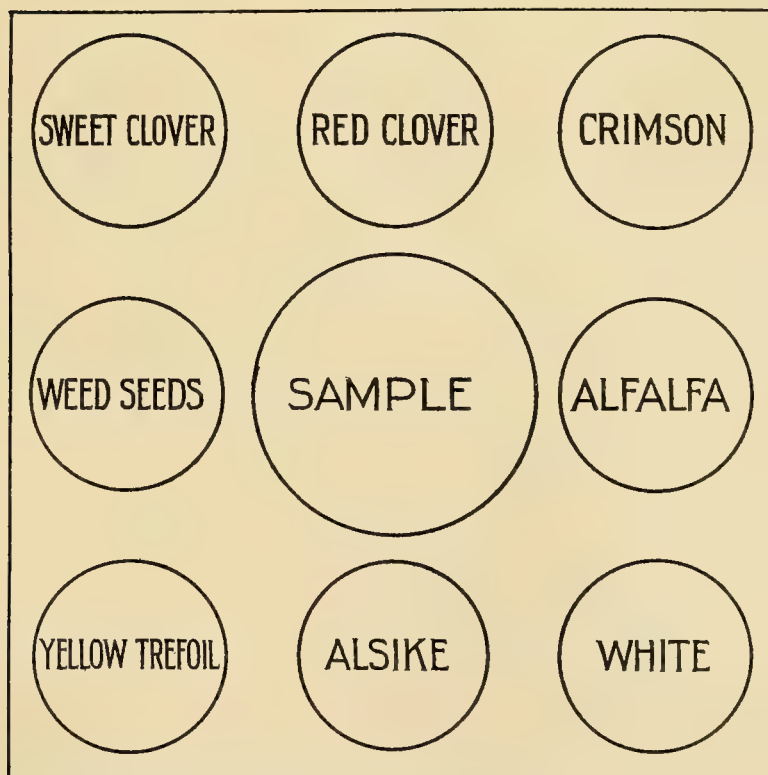
EXERCISE 37.

DATE

IDENTIFICATION OF LEGUME SEEDS.

The small vial supplied contains a mixture of small seeded legume seeds together with other foreign matter. Pour one-third of the seed from the vial on a sheet of scratch paper, and separate from the mixture all of the red clover seed. Then remove the alfalfa seed into another group and so on, so that when the separation is completed all of the seeds of one kind will be in one pile and all of another kind in another pile, etc.

SUGGESTED PLAN FOR MAKING SEPARATION.



EXERCISE 38.

DATE

PURITY TEST OF COMMERCIAL SEEDS.

The vial supplied contains a commercial sample of seed. The kind of seed is labeled on the vial. Make a determination for purity in the following manner. Accurately weigh up two grains of seed from the sample, pour out upon a piece of scratch paper as in exercise thirty-seven, and separate in as many groups as there are kinds of seeds present. Blasted, shriveled or otherwise injured seeds are considered pure seed. Tabulate the results in the outline.

Sample of.....seed

Weight of sample used.....

Number of Sample.....									
Weight of pure seed.....					Per cent...				
*Weight of weed seed.....					Per cent...				
Weight of other foreign seeds.....					Per cent...				
Weight of inert matter.....					Per cent...				
Total Weight.....					Per cent...				

	Sample No.	Sample No.	Sample No.
Weed seeds found:

Other seeds found:

*When weed seeds or foreign matter are present in very small amounts, they need not be weighed, but may be expressed by number (as determined by counting), or as a trace. The per cent of pure seeds, if over 99%, can be indicated as 99+.

EXERCISE 39.

DATE

GERMINATION TEST OF LEGUME SEEDS.

Count out one hundred seeds from the pure sample and place in the germinator. It should be remembered that shriveled, blasted or otherwise injured seeds are considered as pure. In counting out the seeds, for the germinating test, they should be taken without regard to their appearance. Run the test in duplicate.

Kind of seed	Seed bed	Temperature	Day for making test
Alfalfa	B—B*	20° C	6
Clover, alsike.....	T—B	20° C	6
Clover, crimson.....	B—B	20° C	4
Clover, mammoth red.....	B—B	20° C	6
Clover, common red.....	B—B	20° C	6
Clover, white.....	T—B	20° C	6

No of sample	No. of seeds used	No. seeds germinating	No. seeds not germinating.		Percentage of germination
			Hard seeds	Dead	
.....					
.....					
.....					
.....					
.....					
.....					
.....					
.....					

*B—B = Between Blotters.

T—B = Top of Blotter.

- (1) What are the common impurities found in Alfalfa seed? Red Clover? Sweet Clover? Alsike?
- (2) What is the standard of purity for commercial alfalfa seed? Red clover?
- (3) If alfalfa seed of standard purity is worth \$12.00 per bushel, what is the actual value of a bushel of alfalfa seed of 82% purity?
- (4) In the purchase of impure seed, is the loss in money value the only consideration?
- (5) From the data obtained in Exercise 38, determine the cost of the weed seed and inert matter, if the commercial seed is quoted at \$10.00 per bushel.
- (6) Why is a representative sample for testing necessary for a reliable test?
- (7) Explain how you would select a representative sample from a bag of seed.
- (8) What are "hard seeds"? What consideration would you give them in reporting a test?
- (9) Locate the areas in United States supplying the various legume seeds.
- (10) Are any of the legume seeds imported? How extensively and from what countries?

EXERCISE 40.

LABORATORY STUDY OF L

(Study of dried

Common name.....			
Scientific name.....			
Annual, biennial, perennial.....			
Place mostly grown.....			
Soil adaptations.....			
Stems:			
Length:			
Size: coarse, medium, fine.....			
Shape: round, square.....			
Surface: smooth, hairy.....			
Branches: none, few, many.....			
Stoloniferous: very, medium, not.....			
Position (in field): erect, decumbent, spreading, trailing.....			
Leaves:			
Arrangement: spiral, two-rowed.....			
Number: abundant, medium, not abundant.....			
Shape: palmately or pennately foliolate.....			
Leaflets:			
Number:			
Shape:			
Surface: smooth, hairy.....			
Edges: serrated, smooth.....			
Persistence: persistent, lacking persistence.....			
Stipules: attached to petioles, free.....			
Inflorescence:			
Natural color of petals.....			
Position: end of leaf bearing stem or branch, in axil of leaf.....			
Kind: raceme, umbel, capitulum.....			
Fruit:			
Seed borne in pods, in capsules.....			
Pod:			
Shape: flat and elongated, spiral.....			
Surface: smooth, hairy.....			
Color:			
Roots:			
Diameter one inch below crown.....			
Forked, not forked.....			
Tubercles: large, small, rounded, irregular.....			

DATE

LUMINOUS FORAGE CROPS.

nature plants.)

[illegible]

EXERCISE 41.

FIELD STUDY OF LEGUMES

(Adapted for last year's students)

Common name.....			
Scientific name.....			
Annual, biennial, perennial.....			
Place mostly grown.....			
Thriftiness: vigorous, medium, weak.....			
No. of plants per sq. ft. for full stand.....			
Stems:			
Position: erect, decumbent, spreading, trailing.....			
Height:			
Shape: round, square.....			
Surface: smooth, hairy.....			
Stooling: stoloniferous, not.....			
Branches: none, few, many.....			
Coarseness: coarse, medium, fine.....			
Leaves:			
Arrangement: spiral, two-rowed.....			
Number: abundant, medium, not abundant.....			
Shape: palmate, pennate.....			
Leaflets:			
Number:			
Shape:			
Surface: smooth, hairy.....			
Edges: smooth, serrated.....			
Color: shade of green.....			
Stipules: attached to petioles, free.....			
Inflorescence (if present):			
Position: end of leaf bearing stem or banch, in axil of leaf.....			
Kind: raceme, umbel, capilitum.....			

Make a final report of the legumes studied, giving the distinguishing characters and including
What are the most common variations that serve as distinguishing characters among the
What vegetative characters determine the value of a legume for hay?
Make a final report of the exercise, giving the distinguishing characters of the legumes s

May or early June.)

DATE

[illegible]

lied, and include the answers to the above questions.

EXERCISE 42.

DATE

STUDY OF GRASS SEEDS.

Make a careful drawing of one of each of the different kinds of grass seeds supplied for the exercise. When there is more than one characteristic shape for the seeds of any one grass, make a drawing of each type. Enlarge the drawing six or seven times. Label all parts in each drawing. After completing the drawings write up a full description of each kind of seed, giving special attention to any characters that are helpful in identification. The following characters should be carefully noted: Size, shape, color and length of flowering glume (when present); the characteristics of the rachilla and palea, and any other important characters useful for identification. The purpose of this exercise is to familiarize the student with the characteristics of the various grass seeds, which knowledge will be necessary in making separations and in conducting the purity test.

EXERCISE 43.

DATE

IDENTIFICATION OF GRASS SEEDS.

The small vial supplied contains a mixture of grass seeds together with other foreign matter. Pour a part of the seed from the vial upon a piece of scratch paper and separate it as in Exercise 37. This is a continuation of Exercise 42 and is desirable for the purpose of gaining further skill in the identification of grass seeds.

EXERCISE 44.

DATE

PURITY TEST OF GRASS SEEDS.

The vial supplied contains a commercial sample of grass seed. Determine the purity in the follow manner: Accurately weigh up one grain of seed from the sample. Pour out upon a piece of paper as in Exercise 38, and separate into as many groups as there are kinds of seeds present. Identify foreign seeds. Tabulate the results in the outline.

Sample of.....seed	Weight of sample used..... ..						
Sample Number.....							
Weight of pure seed.....				Per cent.....			
*Weight of weed seed.....				Per cent.....			
*Weight of other foreign seeds.....				Per cent.....			
*Weight of inert matter.....				Per cent.....			
Total weight.....				Total percent.....			

	Sample No.	Sample No.	Sample No.
Weed seeds found:			
Other seeds found:			

*When present in small amounts, may be indicated by number or by "a trace."

- (1) What are the common impurities of the following grasses:—Kentucky Blue Grass, Orchard Grass, Red Top, Timothy and Brome Grass?
 - (2) How may the impurities indicate the source of seed. Give several examples.
 - (3) Which of the above grass seeds are imported in large amounts? From what countries?
 - (4) Does the United States export grass seeds? What kinds and to what countries?
 - (5) The seeds of what grasses are likely to be low in vitality? Can you give any reasons for the general lack of vitality?
 - (6) Calculate the actual value of the samples you have tested, if pure seed of perfect vitality is selling at prevailing market quotations.
-

EXERCISE 46.

DATE

COLLECTING AND MOUNTING OF LEGUMES AND GRASSES.

Collect from the grass garden or from the fields a typical specimen of each of the grasses and legumes studied in the proceeding exercises. Prepare the specimens for mounting by drying in the herbarium press. After pressing and drying mount each specimen on cardboard mounts which are furnished. Correctly label with common and scientific name, the date of collection, and the name of the collector. When possible, attach to the mount several seed pods together with a number of seeds of the specimen. Seeds and seed pods of some of them may be secured from the laboratory.

EXERCISE 47.

DATE

LABORATORY STUDY OF PEAS AND BEANS.

This exercise is arranged to familiarize the student with the appearance and characteristics of field beans and peas, cow peas, and soy beans. Several of the common varieties of each are provided for study and comparison. Both the dried plants with pods and the threshed grain should be examined in securing information necessary to fill out the outline.

Variety				
Plant — (erect, decumbent, bushy).....				
Stems — number				
Length — (long, medium, short).....				
Surface — (smooth, hairy).....				
Leaves — position				
Shape				
Number — (few, many).....				
Retention — (good, poor).....				
Surface — (smooth, hairy).....				
Pods — position —				
Number — (few, many).....				
Length — (long, short).....				
Shape — (curved, straight, twisted).....				
Color				
Surface — (hairy, smooth).....				
Grain —				
Size — weight of 100.....				
Shape — round, kidney shaped, etc.....				
Surface — (rough, grooved, smooth).....				
Color — 1 — body				
2 — eye				

EXERCISE 48.

LABORATORY STUDY

(A study of dr

Common name.....			
Scientific name.....			
Place grown.....			
Stooling: very stoloniferous, medium, not.....			
Culm, number:			
Height (inches).....			
Position: erect, decumbent at base, decumbent.....			
Size: coarse, medium, slender.....			
Shape: round, elliptical, lenticular.....			
Color:			
Foliage:			
Abundance: abundant, scanty.....			
Distribution: basal foliage abundant, culm foliage abundant.....			
Leaf Sheath:			
Surface: smooth, downy, scabrous.....			
Clasping: split to node, partly split, closed.....			
Length: relation to length of blade—constant or variable...			
Leaf blade:			
Length—average of 5.....			
Width—average of 5.....			
Midrib: prominent, medium, indistinct.....			
Veins: prominent, medium, indistinct.....			
Ligule: large, medium, small.....			
Inflorescence:			
Shape: panicle, open and spreading, compressed, spike like...			
Length of			
No. of flowers per spikelet.....			
Outer glumes: longer than flowering glume, shorter.....			
Adapted for: hay, pasture, both.....			

What are the desirable features of a pasture grass? Of a hay grass? Of a grass to be used for seed production?
Make a final report of the exercise, dwelling upon characters that, in your opinion, serve as marks of distinction. Indicate

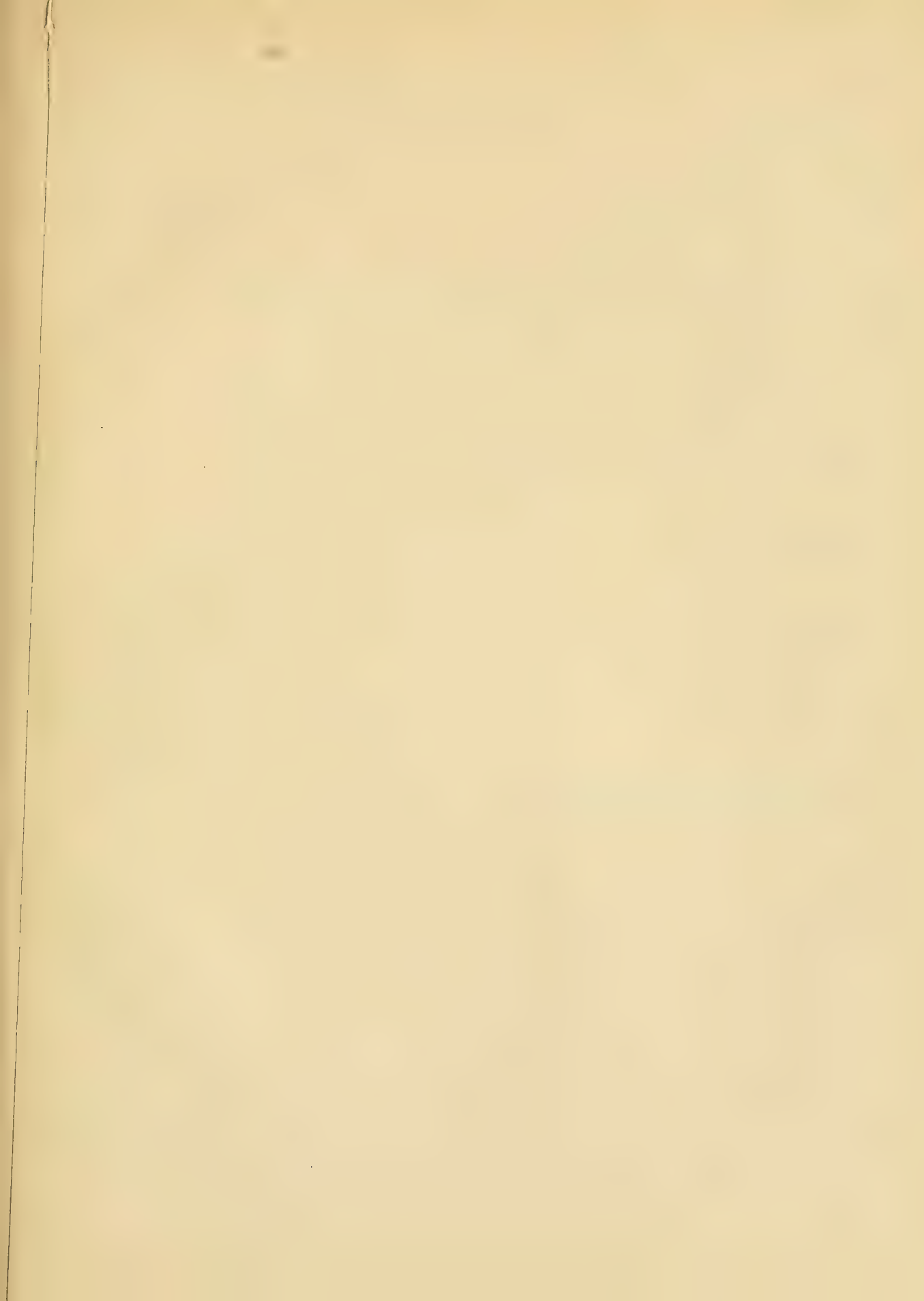
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PERENNIAL GRASSES.

, mature plants.)

[illegible]

to the relative usefulness, as crops, of the grasses studied.



EXERCISE 49

FIELD STUDY OF (Adapted for last

Common name.....			
Scientific name.....			
Place mostly grown.....			
Stiffness: vigorous, medium, weak.....			
Habit of growth.			
Stooling: very stoloniferous, medium, not.....			
Diameter of plants (average of 10 plants).....			
No. of plants per square foot for full stand.....			
Flowers:			
Color: white, brown, red.....			
Depth: deep or shallow — medium.....			
Stems:			
Number per plant (average 10 plants).....			
Height—_inches (average 10 plants).....			
Position: erect, decumbent at base, decumbent.....			
Size: coarse, medium, slender.....			
Shape: round, elliptical, lenticular.....			
Color:			
Foliage:			
Abundance: abundant, medium, scanty.....			
Distribution: basal foliage abundant, culm foliage abundant.			
Leaf sheath: smooth, downy, scabrous, split to node, partly split, closed			
Leaf blade:			
Length—average of 5.....			
Width—average of 5.....			
Position: erect, ascending, drooping.....			
Midrib: prominent, medium, indistinct.....			
Surface: smooth, downy, rough.....			
Color: shade of green.....			
Adapted for: pasture, hay, both, lawn, etc.....			
Inflorescence (if present):			
Shape: panicle, open and spreading, compressed, spike like.....			
Length—average of 5.....			
No. of flowers per spikelet.....			
Color:			

Make a final report of the grasses studied, noting variations that may serve as points of distinction.

May or first of June.)

DATE

[illegible]

EXERCISE 50.

DATE

STUDY OF MILLETS.

Variety				
Culm — Height — (inches)				
Position — (erect)				
Size — (coarse, medium, slender)				
Shape — (round, elliptical, etc.)				
Color				
Foliage — Abundance — abundant, scanty				
Length — long, medium, short				
Width — wide, medium, narrow				
Color				
Inflorescence — Shape — panicle, spike				
Length'				
Size — heavy, light				
Seeds — Size				
Shape				
Color				

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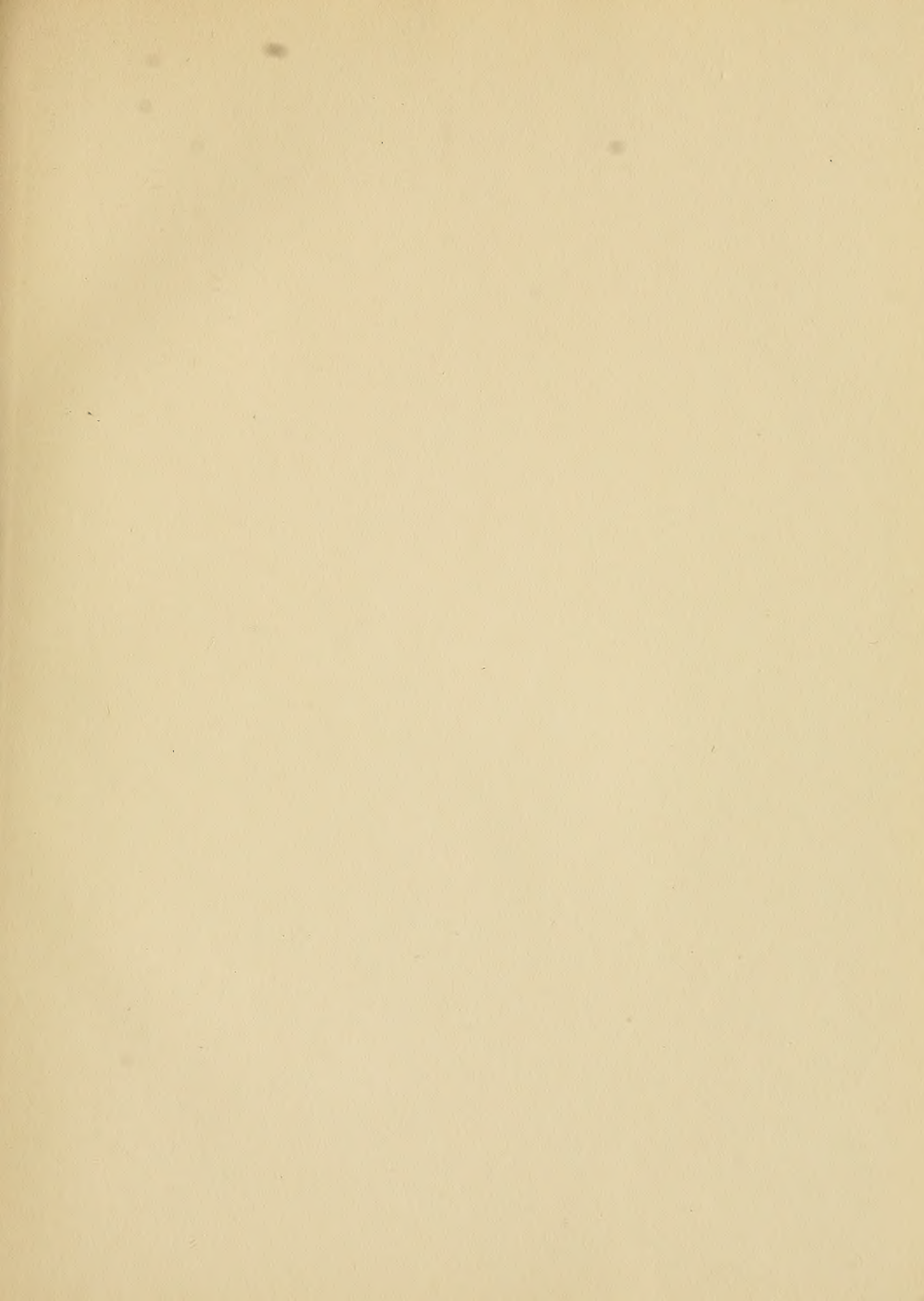
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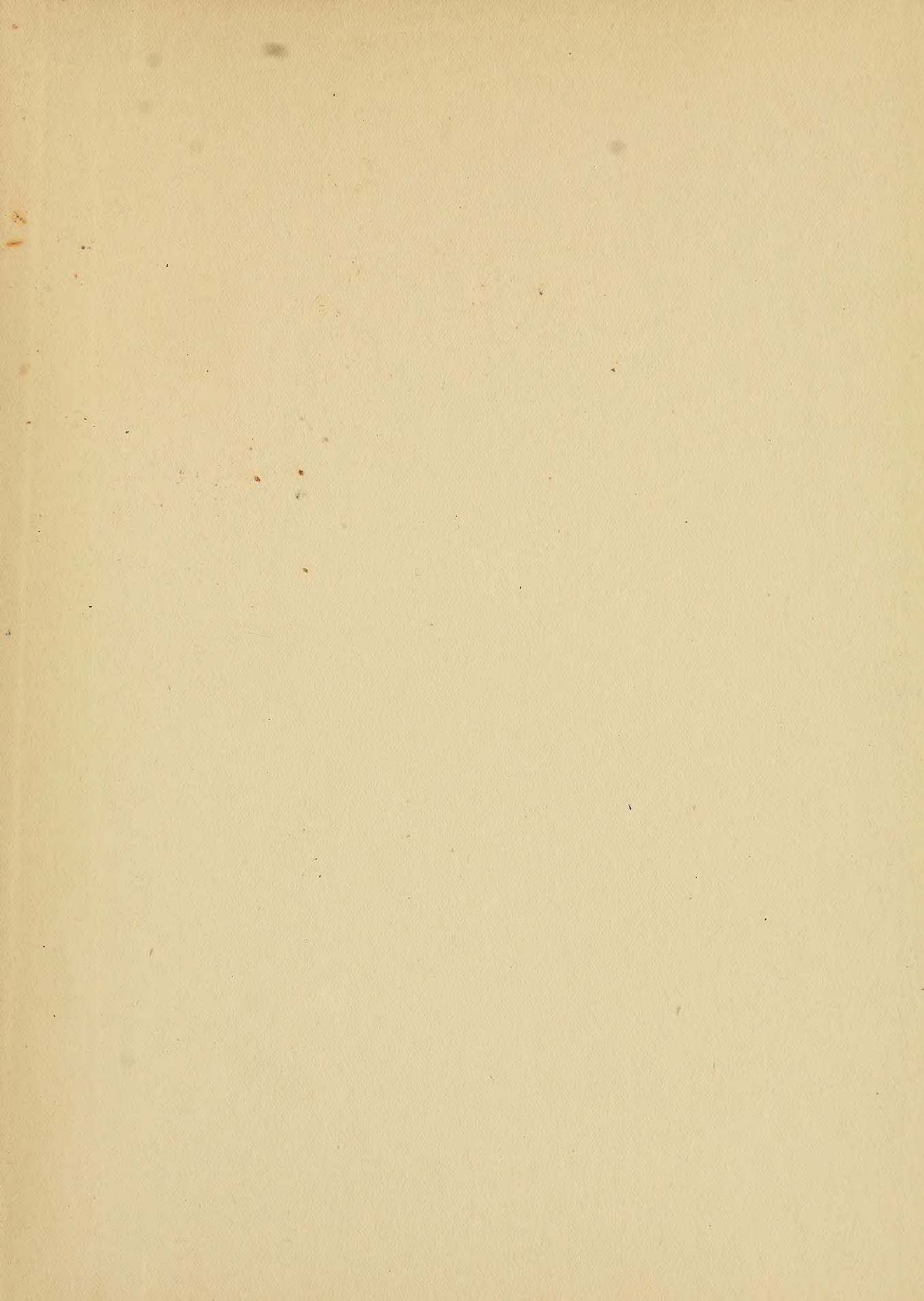
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